The surface currents that matter to offshore infrastructure

Forum for Operational Oceanography: Waves and Currents Session

Matt Rayson

22nd November 2021

Oceans Graduate School
University of Western Australia

ARC Research Hub for Offshore Floating Facilities

ARC Research Hub for Transforming energy Infrastructure through Digital Engineering

THE UNIVERSITY OF WESTERN AUSTRALIA

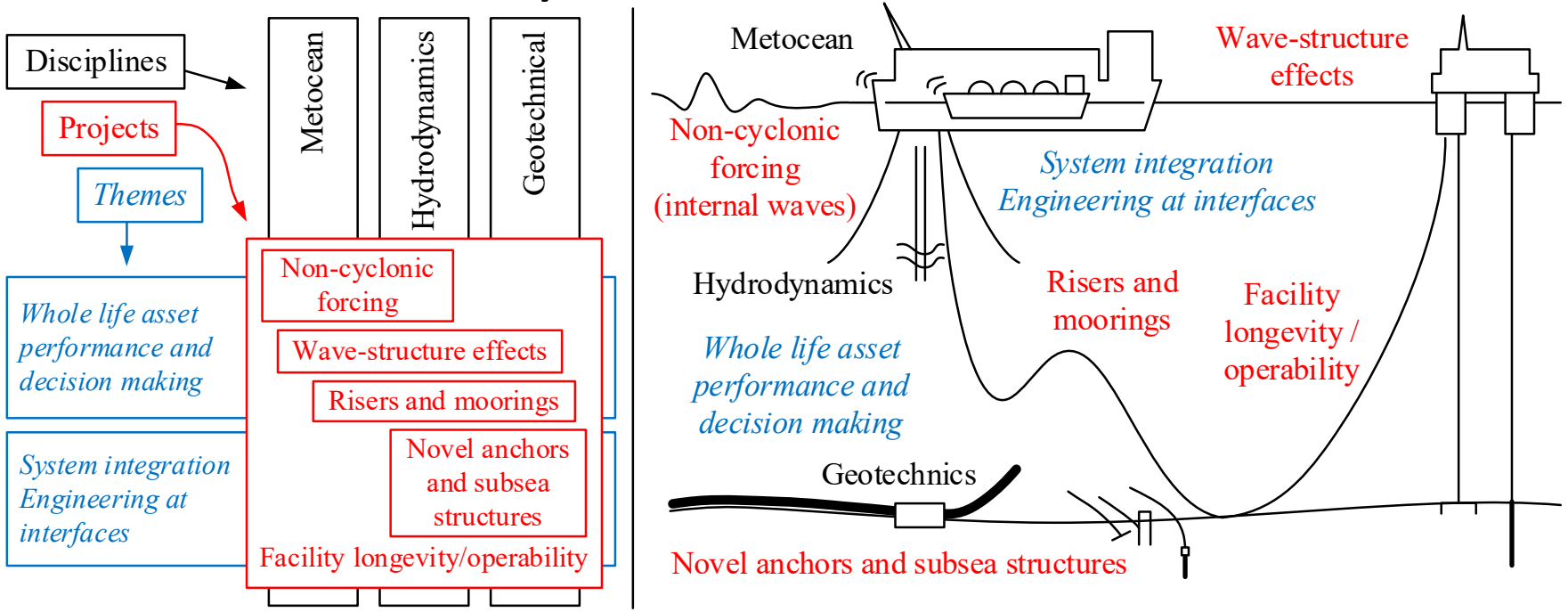
ARC Research Hub for Offshore Floating Facilities

Industrial Transformation Research Hub for Offshore Floating Facilities

THE UNIVERSITY OF WESTERN AUSTRALIA

- Aim: to address the critical engineering challenges associated with Australia's next generation of offshore oil and gas projects
- 15 academics (UWA, WSU), 5 post-docs, 15 PhDs
- ARC contribution of $5M over 5 years (2016 – 2021), matched by industry

→ Oceanography (metocean) focus: <u>Characterisation</u> of nonlinear internal waves and boundary turbulence in the offshore environment



Hub Director:
Shell EMI Chair of Offshore Engineering
Prof. Phil Watson

Hub Manager:
Dr Andrew Grime

Australian Government
Australian Research Council

woodside

Lloyd's Register

BUREAU VERITAS

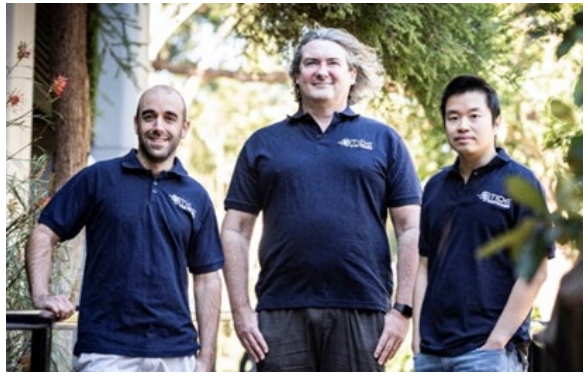
WESTERN SYDNEY UNIVERSITY

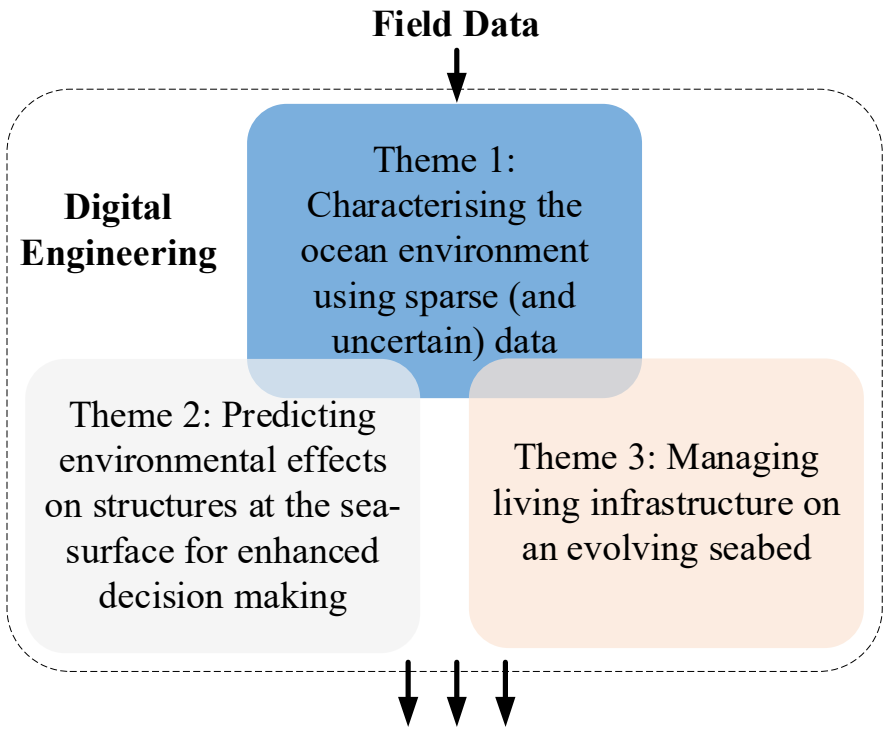
Transforming energy Infrastructure through Digital Engineering Research Hub

Development of new science and technology through ***digital engineering*** to optimise the management of offshore energy infrastructure – thereby making this activity cheaper and yet more reliable.

Digital Engineering is the creation, use and embedment of data in engineering.

Oceanography focus: Prediction of nonlinear internal waves and submesoscale eddies using "traditional" physical models and new "data science" methods





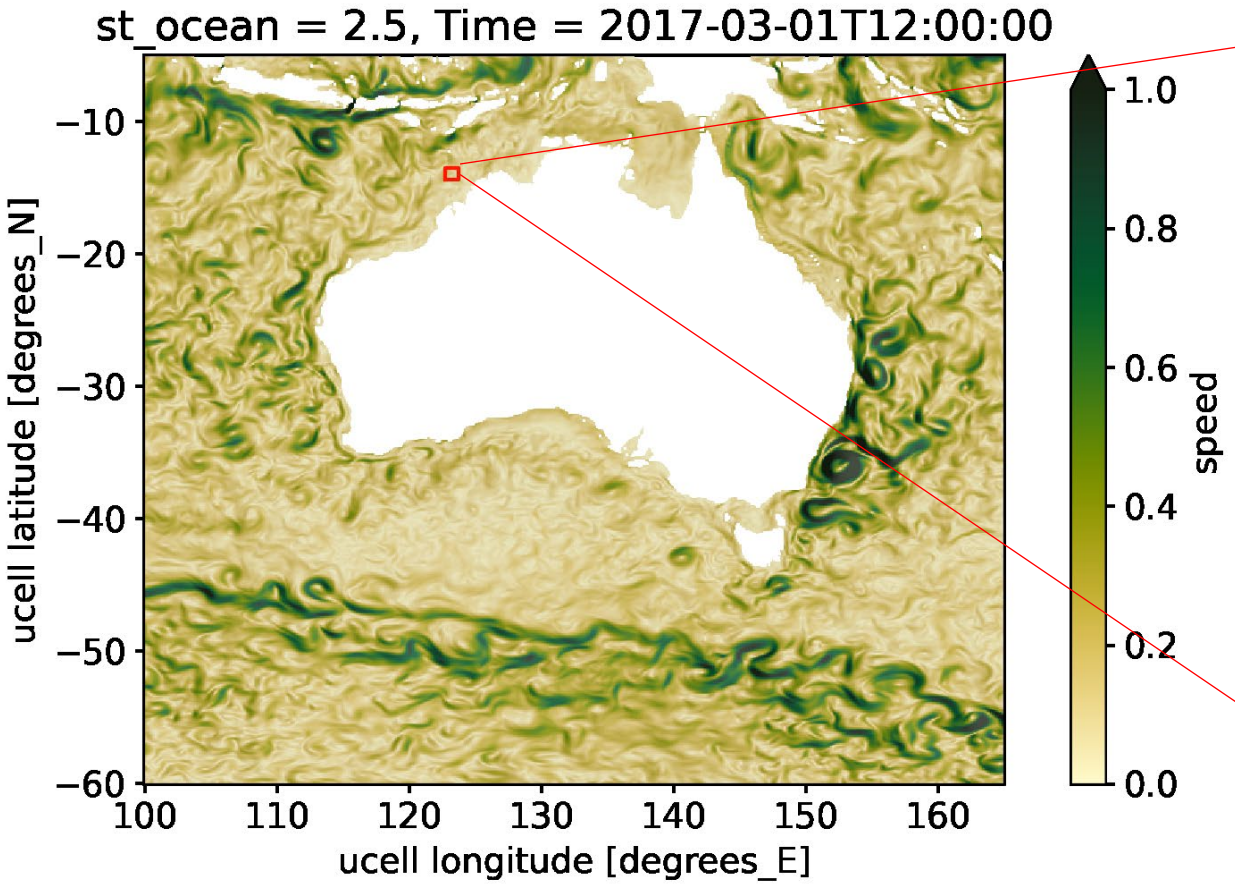
New science and technologies to transform operation of offshore energy infrastructure

agile decision-making | improved safety | increased efficiency
long-term reliability | lower environmental risk

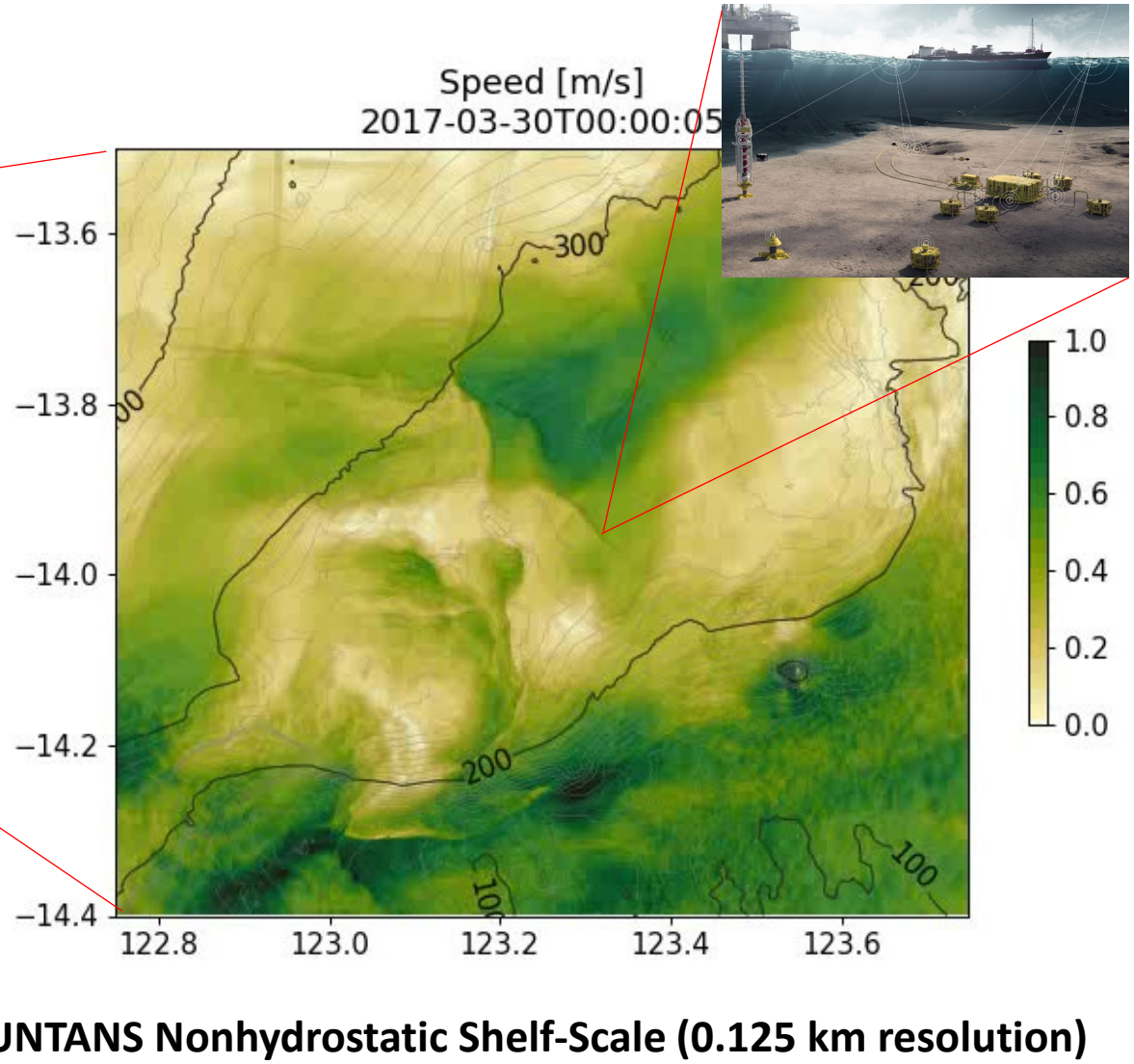
What type currents matter to offshore infrastructure?

THE UNIVERSITY OF WESTERN AUSTRALIA

A: Currents at ALL time- and space-scales



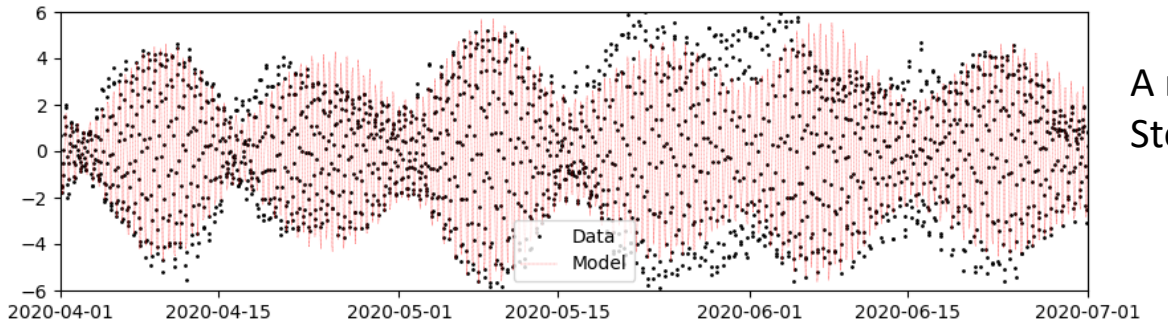
Bluelink Reanalysis (v2020), 10 km resolution



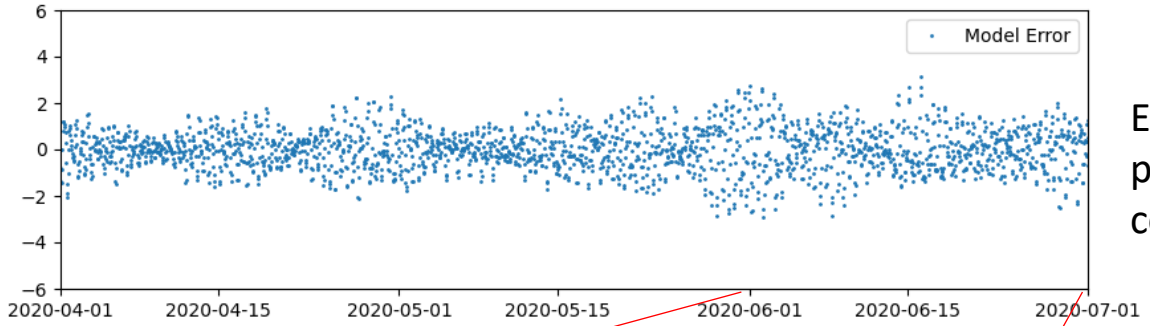
SUNTANS Nonhydrostatic Shelf-Scale (0.125 km resolution)

Prediction by combining physical models with data*

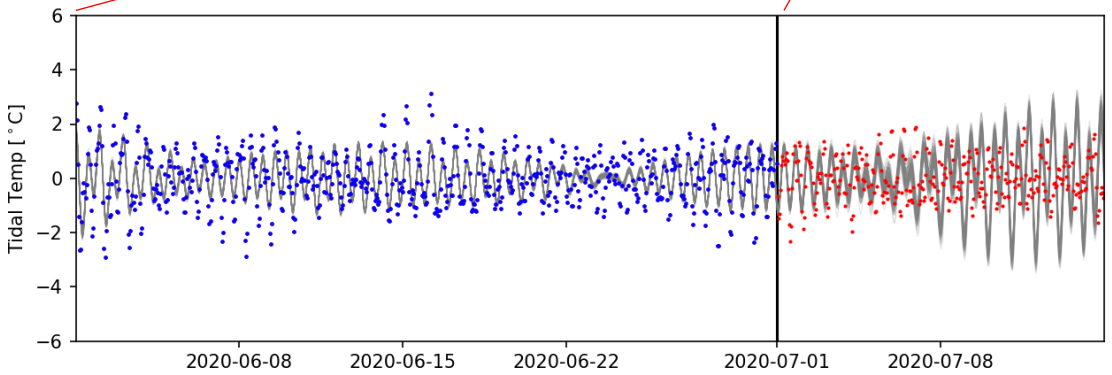
Ocean quantity (e.g. velocity, wave height, temperature)



A model (e.g. a Navier-Stokes ocean model)



Error due to e.g. unresolved physics, unknown boundary conditions…



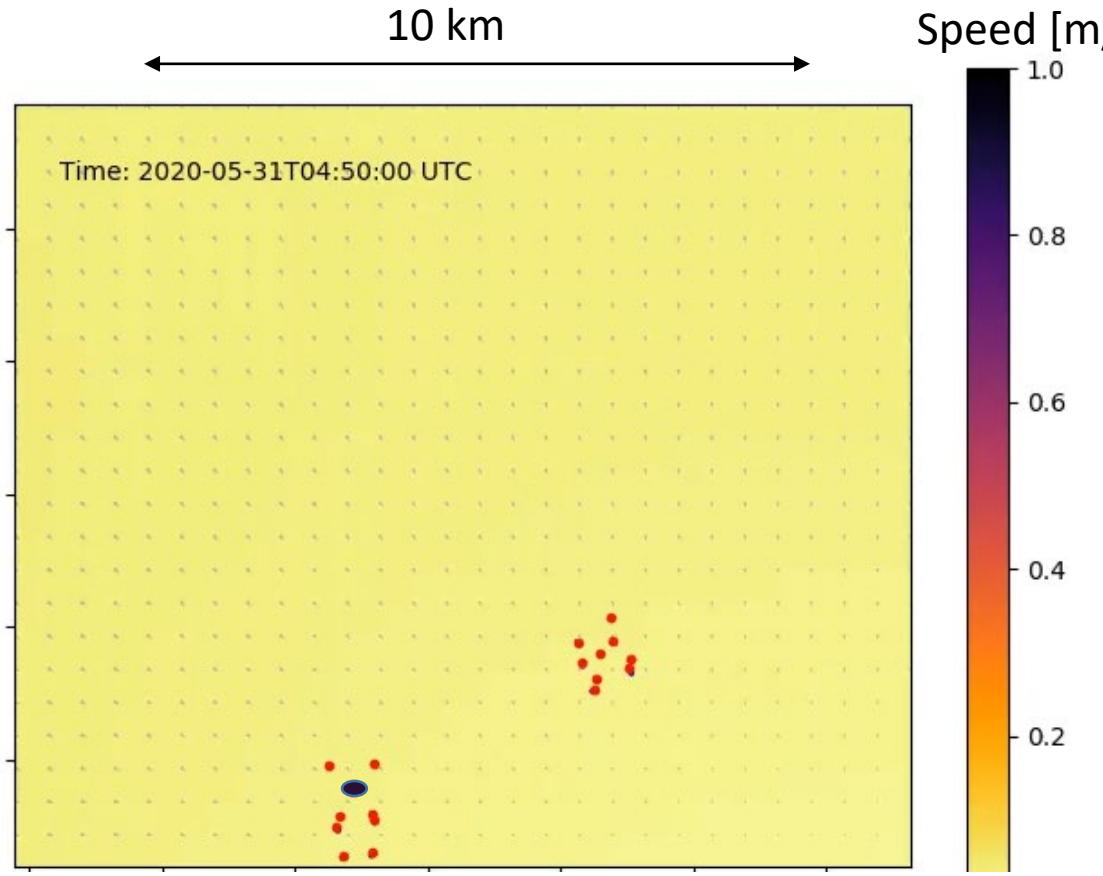
"Data science" prediction e.g. neural networks, Gaussian Process regression

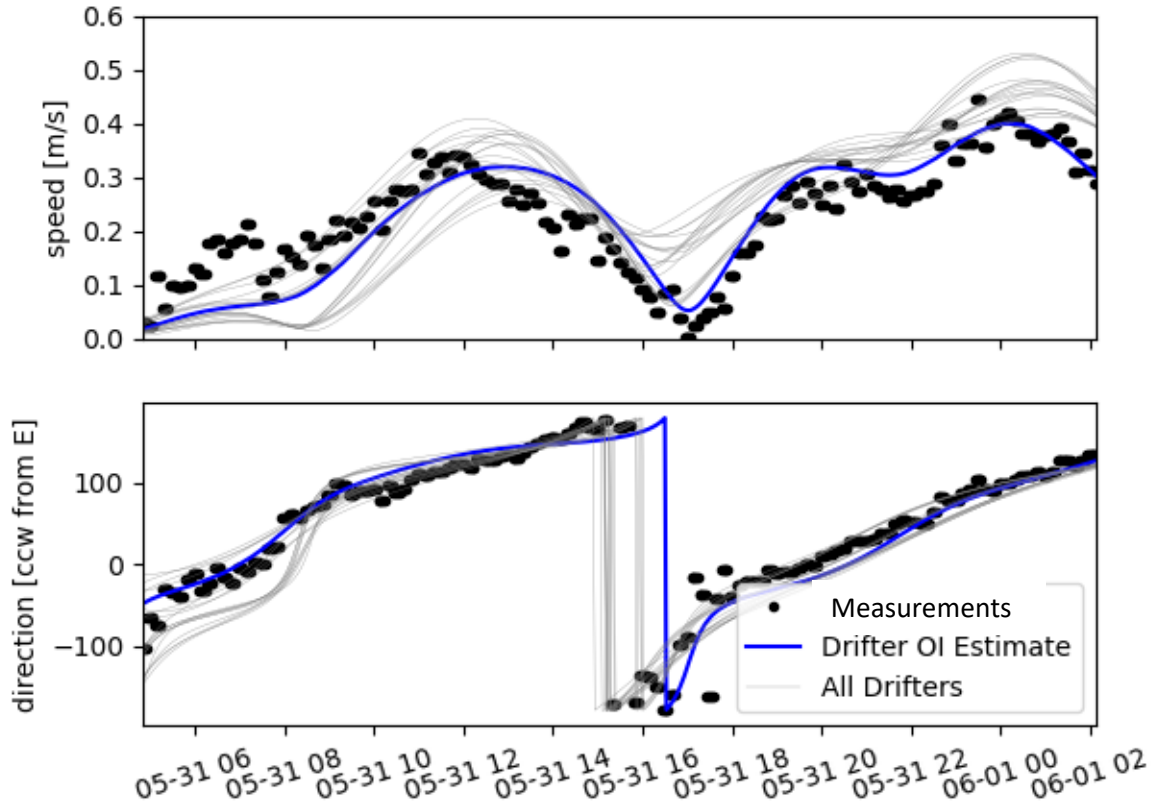
***combining models with data, aka:**

- Data assimilation

“Data-driven” methods:

when there is too much uncertainty in our model inputs





Satellite-tracked drifter velocity vectors (blue) and reconstructed using *optimal interpolation surface currents (grey)

***optimal interpolation aka:**

- Gaussian Process Regression
- Machine Learning
- Surface Fitting…

Data acknowledgement: UWA Shell Chair (Prof. P. Watson), UWA Coastal Oceanography (Prof. C. Pattiaratchi)

Transforming energy Infrastructure through Digital Engineering Research Hub

Our partners (more coming)